

SAN FRANCISCO ESTUARY PROJECT

Sacramento–San Joaquin Delta

The Sacramento–San Joaquin Delta serves a multitude of purposes and presents a variety of management challenges—from preserving its important fisheries, wildlife and water quality to managing Delta levees and water flows to meet the needs of agricultural and urban users. Each challenge brings with it opposing points of view, special interest groups and new concerns. By building regional consensus around these concerns, the San Francisco Estuary Project promotes environmentally sound management of the Bay and Delta.

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Largemouth Black Bass

The Estuary

The San Francisco Bay-Delta Estuary conveys the waters of two great California rivers into the Pacific Ocean and drains nearly half the state. The Estuary sustains rich communities of crabs, clams, fish, birds and other aquatic life—serving as both an important wintering site for migrating water-

fowl and as a spawning area for anadromous fish. Its 1600 square miles of waterways, wetlands and bays also form the centerpiece of America's fourth largest metropolitan region—enabling residents to pursue fishing, sailing, shipping, farming, oil refining and a host of other important economic and recreational activities.

History

The Delta as we know it would not exist without human intervention. In the late 1700s, early Spanish explorers found a vast tidal marshland covered in bulrushes called tules. Trappers soon took advantage of the area's abundant wildlife, and seagoing ships navigated the Sacramento and San Joaquin rivers transporting supplies in and tallow and furs out. Agriculture also developed as settlers reclaimed land by draining marshes, constructing levees and burning the tules.

In the late 1800s, hydraulic gold mining in the Sierra Nevada caused enormous damage to the Delta. The use of high-pressure water to wash away hillsides swept vast amounts of debris and sediment downstream—altering the navigability of river channels, hindering shipping activities, exacerbating flooding and causing water quality problems.

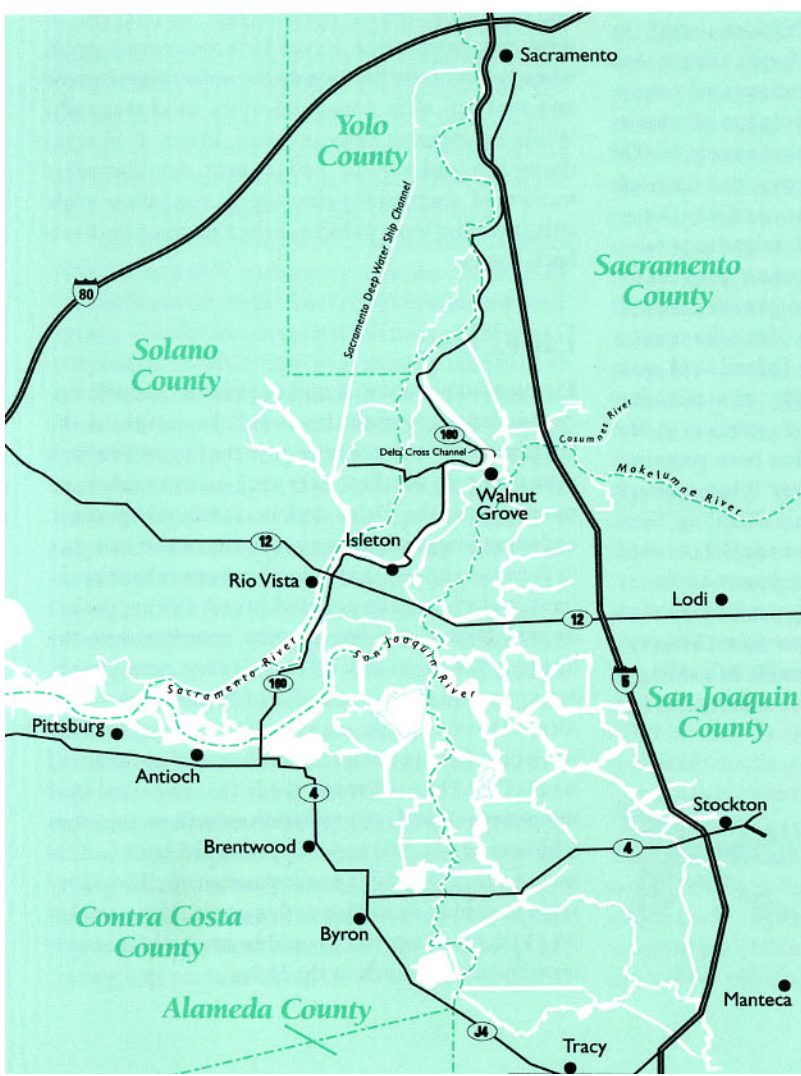
To maintain shipping access, many Bay and Delta channels had to be dredged. Much of the material brought up from the Estuary floor by dredging was used to build levees to protect farmland from flooding and fill wetlands to create new fields.

Further modification of the Delta came in the middle of this century. Construction of the world's largest system of dams, canals and reservoirs provided California with its first dependable source of water for farms, industry and towns statewide. These federal and state water projects also diverted large amounts of fresh water away from the Delta.

The Delta

The Delta lies at the upper end of the San Francisco Estuary at the confluence of the southward-flowing Sacramento and the northward-flowing San Joaquin rivers. In the Delta, the two rivers mingle with the smaller Sierra Nevada and Coast Range rivers in a maze of channels and sloughs extending for 700 miles. The Delta includes 57 islands, 1,100 miles of levees and hundreds of thousands of acres of marshes, mudflats and farmland. It provides valuable soil and water for agriculture, habitat for migratory and warm-water fish and shelter for aquatic birds and waterfowl. The Delta and its watershed also provide drinking water to 20 million Californians and irrigation water to 4.5 million acres of farmland.

Credit: California Department of Water Resources





Catfish

Areas of Concern

Delta Uses

Wildlife Habitat: The Delta's diverse saltwater and freshwater ecosystems provide important habitat for millions of migrating and resident waterfowl, fish and other flora and fauna. Two hundred and thirty species of birds, 52 species of fish, and 45 species of mammals live in the Delta—some of which appear on federal/state lists of rare, threatened or endangered species. Many of these are introduced species.

Agriculture: Agriculture is the number one industry in the Delta, producing gross annual sales of over \$500 million. About three quarters of the Delta's 520,000 acres of cultivated agricultural land is farmed with water diverted from 1800 locations along Delta channels and sloughs. The main crops include corn, other grains, hay, sugarbeets, alfalfa, tomatoes, asparagus, fruit, safflower and pasture.

Recreation: The Delta supports over 12 million user-days of recreation annually, from boating and water-skiing to hunting and sport fishing. Thousands of people also visit the Delta for sight-seeing and bird watching.

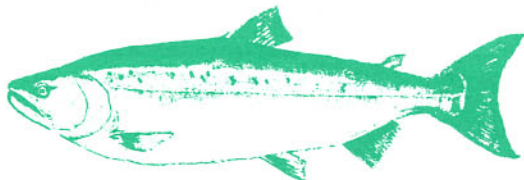
Cities/Towns: There are five incorporated cities entirely within the Delta: Antioch, Brentwood, Isleton, Pittsburg and Tracy, and 14 unincorporated towns and villages, covering an area of approximately 35,000 acres. Thirteen of the islands and tracts are uninhabited by humans.

Water: The Delta is the hub of the state's water distribution system and provides almost 55 percent of the state's managed freshwater supply, including 40 percent of its drinking water. The water is distributed through canals and aqueducts to Stockton, Sacramento, San Francisco and East Bay municipalities, to industrial users in the Bay Area, to the agriculture-rich San Joaquin Valley and to Southern California residents. Over the years, water diverted from the Delta has helped turn California's semi-arid Central Valley into a productive agricultural area and allowed continued growth in areas without adequate local water supplies. In California, agriculture uses almost 85 percent of the managed water, while cities and industry consume the remaining 15 percent.

Fish and Wildlife

Birds The Delta is a critical stop-off point along the Pacific Flyway, a major north-south migration route for millions of migratory waterfowl and shorebirds. Since 1900, these populations have decreased by about 75 percent. Changes in Delta agricultural cropping patterns and in water quality will further impact wildlife use of the area, particularly the 450,000 to 600,000 waterfowl and migratory birds that use seasonally flooded fields. Ducks Unlimited and other organizations work with farmers in the Delta to provide habitat for waterfowl and other migratory birds on agricultural land during the non-growing season.

Fish Recent decades have seen major declines in the populations of many fish, including delta smelt, shrimp, American shad, Chinook salmon and striped bass. The striped bass, introduced to the Estuary in 1879, supported a large commercial industry until the 1930s. As an indicator species for the Bay-Delta ecosystem, the striped bass has experienced a significant drop in population, which indicates a decline in the overall health of the Estuary. This decline has spurred research into possible causes. Chinook salmon populations have also dropped sharply in recent years. The winter-run Chinook salmon was placed on the federal and state endangered species lists in 1992. The estimated population of winter-run salmon decreased from approximately 50,000 in 1971 to only 189 in 1994. Spring-run Chinook salmon populations are also low, partially due to dams blocking and altering historic migration routes. Hatchery production mitigates some impacts of the decline in salmon populations, but populations still remain below historical averages. The delta smelt, a native fish, was placed on the federal and state threatened species lists in 1993 after several studies showed a significant drop in abundance in the 1980s. The Sacramento splittail has been proposed for listing as a threatened species. While there is agreement that fish populations are declining, there has been considerable disagreement over the causes. Among the possible causes are exposure to toxics, decreased food supply (including primary production and plankton), reverse flows (see *Glossary*), entrainment (see *Glossary*) of juvenile fish and eggs in water project pumps, changes in salinity and loss of habitat and spawning grounds.



Chinook Salmon

Levees and Flooding

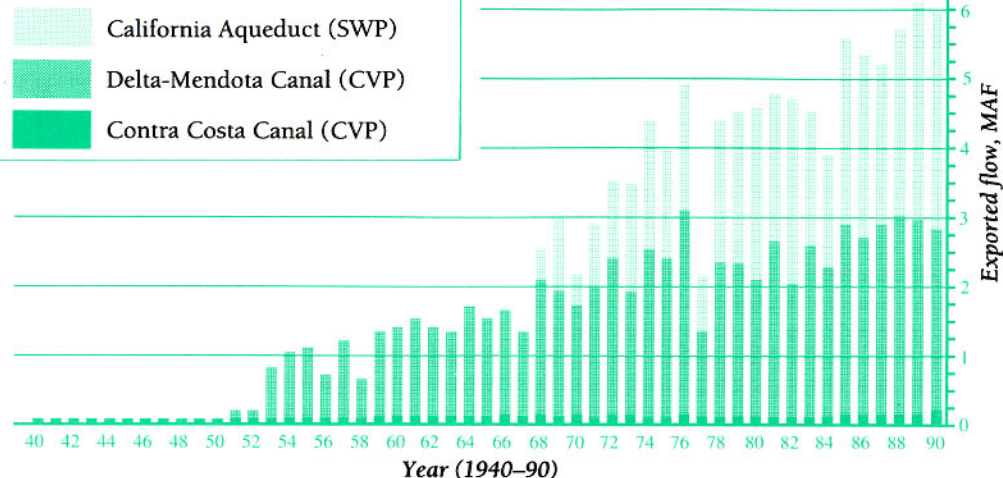
During the mid-1800's, local land owners constructed levees to hold back water and create islands of dry land to be used for farming. Some Delta soil, comprised of compressed tules from original marshlands, sinks or erodes at the rate of about three inches per year. As a result, many Delta islands are below the surrounding water level; some are more than 20 feet below sea level. This subsidence places added stress on levees and makes island flooding more probable. Since the first island was reclaimed, each of the 70 islands or tracts has flooded at least once. A large magnitude earthquake also could be devastating for the levee system. Studies have shown that long stretches of Delta levees built over sand pockets could liquify under severe seismic loads. Furthermore, the wakes from an increasing number of recreational boats may add stress to the levees. The recently introduced Chinese mitten crab, whose existence was officially established in 1994, poses a different problem for the levees. If the crabs migrate from the Bay into the Delta, they could burrow into the levees, weakening them and increasing the risk of failure.

Today, many Delta levees are in dire need of repair and pose considerable flood danger. In response to these concerns, some levees have been rip-rapped, whereby natural vegetation on the water side is cleared and replaced with rocks and other solid materials. While rip-rapping helps stabilize levees, it also reduces fish and wildlife habitat area. An alternative method of maintaining the natural vegetation while still providing levee stability is the construction of set-back levees.

Land Use

Increased development and population growth upstream have adversely impacted the health of the Delta and will continue to do so in the future. Workers priced out of the Bay Area real estate market are moving into the Delta and its surrounding cities, enduring longer and longer commutes and bringing to their new homes many development-related problems, including more polluted runoff. During the last decade, Solano and San Joaquin counties were the fastest growing in the 12-county Bay Area region. Many people are concerned that increased development may occur at the expense of protecting valuable wetlands, fish and wildlife habitat and agricultural lands. One Estuary Project study that projected land use patterns based on population growth projected an addition of 331,530 acres of urbanized land (a 37% increase by 2005) if full development in the 12-county region occurs. According to this projection, a total of 39,511 acres of wetlands could be impacted, particularly farmed wetlands in the Delta.

Historic Delta Exports, 1940–1990



Water Diversion and Salinity

Ninety percent of the Estuary's fresh water originates as precipitation in the Central Valley hydrologic basins of the Sacramento River, San Joaquin River and Central Sierra-Delta and flows through the Delta. The annual Delta inflow from 1921 to 1990 has ranged from under 8 million acre-feet (MAF) to over 60 MAF. During the period 1980–1991, the Department of Water Resources estimates that the average annual inflow to the Delta was 27.8 MAF. However, much of this water was diverted before it reached the ocean. The state and federal water projects currently export approximately 6 MAF per year, and nearly 1 MAF is diverted in the Delta for agriculture. Combined with upstream diversions of 9.4 MAF, over 16 MAF annually never reach San Francisco Bay. These figures are expected to change with the implementation of the new Bay-Delta standards. (See *Current Issues*.)

The diversion of water from the Bay and Delta has fueled a statewide controversy over the extent of its adverse impact upon the Estuary's ecosystem and water quality. The declines in several fish runs and in phytoplankton abundance have been partially attributed to low flows. The water diversions lead to a phenomenon known as "reverse flows" (see *Glossary*), confusing fish and sending many into project pumps. The timing of freshwater flows may be the most important factor in determining fish survival. Late spring and early summer flows are typically high as Sierra Nevada snowpack melts and runs off. According to fishery biologists, this spring cycle creates conditions favorable to migration and spawning for anadromous fish. Spring, however, is also the season when water projects are capturing much of the runoff and filling reservoirs for the dry summer months.

Saltwater intrusion into the Delta is also linked with the diversion of fresh water and the corresponding decrease of freshwater outflow from the Delta. After a prolonged drought or during the spring when reservoirs are being filled, Delta outflow is low. As a result, the western Delta and Suisun Bay often experience increased salinity during the spring and summer months. Also contributing to

increased Delta salinity levels is the discharge of agricultural drainage that is often saline. The increased salinity levels can adversely affect drinking water quality, aquatic habitat and the productivity of Delta agricultural land. To combat these problems, freshwater flows have historically been artificially manipulated by releasing water from reservoirs in the summer and fall.

Pollutants

Pollutants enter the Delta and Bay via discharges from industrial and sewage treatment plants, but predominantly from sources such as runoff from urban and agricultural land. Runoff contains oil, grease, pesticides, herbicides, fertilizers and many other chemicals. Pollution from runoff does not have the same degree of regulatory control as is required for dischargers, and information on runoff pollution is incomplete. However, much attention is now being focused on runoff since it is recognized as contributing a majority of the pollution to Bay and Delta waters. The 1990 Coastal Zone Act Reauthorization Amendments require that states adopt a program to reduce both urban and agricultural runoff by July, 1995, and implement the program within three years.

Drinking Water

Protecting Delta water quality is equally important to Delta farmers and urban and agricultural users throughout the state. When water is purified for consumptive purposes, it is treated with chlorine compounds. Several chemical by-products of concern are created by this treatment. Trihalomethanes (THMs) and bromate, which are health risks and potential carcinogens, are formed when chlorine compounds chemically react with the organic matter and bromide in the water. Organic matter and bromide, referred to as precursors, are predominantly traced to the region's soils and ocean water, respectively. Water treatment facilities routinely monitor for THMs and try to minimize the level of precursors entering the facilities.

Glossary

acre-foot: An acre of water one foot deep; approximately 326,000 gallons. The typical California family of five uses an acre-foot of water in and around the home each year.

anadromous: Fish that live some or all their adult lives in salt water but migrate to fresh water to spawn (reproduce).

brackish: Water that is somewhat salty, but less salty than seawater.

delta: An area formed by alluvial deposits of sand, silt, mud and other particles at the mouth of a river.



Delta Smelt

entrainment: Preventing the passage of a particle or object such as a fish while allowing other matter such as water to proceed.

entrainment zone: The area where salty ocean water moving upstream mixes with fresh water flowing downstream. Mixing dynamics in this zone trap nutrients and organic and inorganic materials such as fish and invertebrate eggs and larvae—concentrating food sources and enhancing plant and animal growth.

food web: Network of interconnected food chains and feeding interactions among organisms.

indicator species: A species whose characteristics show the presence of specific environmental conditions.

plankton: Microscopic plants and animals that drift with the currents.

reverse flows: When freshwater inflow is low and export pumping is high, the lower San Joaquin River changes direction and flows upstream.

riparian: Relating to or living on the bank of a natural waterway.

subsidence: Lowering or sinking of land caused by compaction, wind and water erosion, oxidation of peat soils and other causes.

THMs: Trihalomethanes are carcinogens that are the by-products of the water disinfection process. They are formed when organic compounds found in water come into contact with chlorine used for disinfection during water treatment.



Current Issues

Resources

San Francisco Estuary Project, 1995

An Introduction to the Ecology of the San Francisco Estuary

Comprehensive Conservation and Management Plan

Estuarywise: 100 Pollution Prevention Tips

Fact Sheets Dredging, Pollutants, Wetlands, Agricultural Drainage, Land Use and others

Status and Trends Reports Aquatic Resources, Wetlands, Wildlife, Pollutants and others

State of the Estuary, 1990: A Report on the Conditions and Problems in the San Francisco Estuary

A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley, September, 1990

Five-Year Report of the Municipal Water Quality Investigations Program: California Dept. of Water Resources, November, 1994

Layperson's Guide to the Delta, Water Education Foundation, Sacramento, 1993

Report of the Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary, 1987

Sacramento-San Joaquin Delta Atlas, California Dept. of Water Resources, 1993

Contacts

CALFED Bay-Delta Program,
1416 Ninth St., Rm. 1155, Sacramento, CA
95814 (916) 657-2666

California Department of Fish and Game,
Bay-Delta Section, 4001 N. Wilson Way,
Stockton, CA 95205 (209) 948-7800

California State Department of Water Resources, P.O. Box 942863, Sacramento, CA
95811 (916) 653-7247

Central Valley Regional Water Quality Control Board, 3443 Router Road, Sacramento, CA 95827-3098 (916) 255-3000

Delta Protection Commission, P.O. Box 530, Walnut Grove, CA 95690 (916) 776-2290

Ducks Unlimited, 9823 Old Winery Place, Suite 16, Sacramento, CA 95827 (916) 363-8257

Friends of the River, 909 12th Street, #207, Sacramento, CA 95814 (916) 442-3155

Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary, 3251 S Street, Sacramento, CA 95816-7017 (209) 948-7800

Sacramento River Preservation Trust, P.O. Box 5366, Chico, CA 95927 (916) 345-4050

San Francisco Estuary Project, 2101 Webster St., Suite 500, Oakland, CA 94612 (510) 286-0460

State Water Resources Control Board, P.O. Box 100, Sacramento, CA 95812-0100 (916) 657-2390

U.S. Army Corps of Engineers, 650 Capitol Mall, Sacramento, CA 95814-4794 (916) 557-5100

U.S. Environmental Protection Agency, 75 Hawthorne, San Francisco, CA 94105 (415) 744-2125

U.S. Fish and Wildlife Service, 2800 Cottage Way, Room E-1803, Sacramento, CA 95825 (916) 979-2710

Water Education Foundation, 717 K Street, Suite 517, Sacramento, CA 95814 (916) 444-6240

Central Valley Project Improvement Act

The Central Valley Project Improvement Act (CVPIA) was passed by Congress in 1992, but litigation has slowed implementation. The CVPIA calls for approximately 15 percent of the federal water project's annual yield to be dedicated to restoration of fisheries and wetlands, including the development of a program that will double the natural production of anadromous fish by 2002, based on the fish populations from 1967-1991. It also provides greater opportunity for water transfers between water contractors and willing buyers.

Delta Protection Commission

The Delta Protection Commission was established in January, 1993, by state law. Its mission is to protect the Delta's resources by adopting land use guidelines that preserve agriculture, wildlife habitat and recreational users' interests in the Delta area. The Commission is comprised of a 19-member board that includes state and local officials from the five Delta counties.

CALFED Bay-Delta Accord

On December 15, 1994, the federal and state governments, urban water users and agricultural and environmental representatives signed an agreement on new Bay-Delta water standards. The agreement covers a wide range of issues, including salinity standards, flow requirements and species protection. The agreement is unique because it represents the first time that water interests were willing to compromise to reach what most believe is a fair and balanced accord. After holding public hearings and soliciting comments on the agreement, the State Water Resources Control Board (SWRCB) adopted the 1995 Bay-Delta Water Quality Control Plan, which contains many of the provisions in the Dec. 15 Agreement. Under its water rights authority, the SWRCB will determine which water users in the Bay-Delta watershed should help meet water quality and flows requirements. The new standards are viewed as shifting management from a constraint on taking endangered species at the pumps to a constraint on operating the water projects in real-time.

Delta Geographic Subcommittee

The Delta Geographic Subcommittee is one of three regional geographic subcommittees established by the San Francisco Estuary Project's Implementation Committee. Its open membership consists of all the interested stakeholders in the Delta. The Subcommittee's purposes are to make recommendations to the Implementation Committee on CCMP implementation and to identify specific actions in the Delta that need implementation. The Subcommittee will research and develop a matrix of Delta projects to determine priorities for Delta restoration and enhancement.

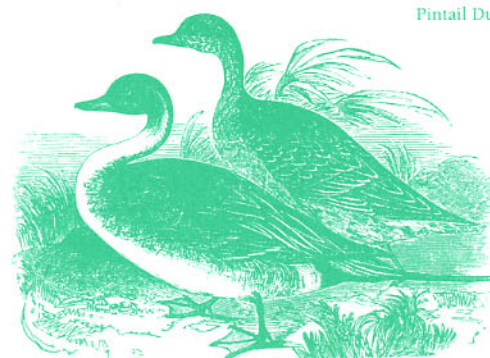
Levee Maintenance

Between 1981 and 1991, the State of California spent more than \$26 million to help maintain and repair over 530 miles of levees. This is in addition to nearly \$37 million spent by land owners and local reclamation

districts. In 1988, the state legislature passed the Delta Flood Protection Act (SB34), which allocated \$120 million over a ten-year period to help stabilize and strengthen Delta levees. However, considerably more funds are needed to address all levee-related problems. The U.S. Army Corps of Engineers dredges Delta channels and performs other activities that provide effective flood control and stronger levees. The Long Term Management Strategy for dredging in the Bay Area is considering the use of dredge materials to construct and reinforce existing levees.

San Joaquin Valley Drainage Program

The San Joaquin Valley Drainage Program issued A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley in 1990. In 1991, a strategy was developed for implementation of the management plan and a five-year plan is being created. Management measures identified in the document include source control, drainage reuse, evaporation systems and land retirement.



Pintail Duck

Estuary Project Goals

The San Francisco Estuary Project's primary goal is to restore and maintain water quality and natural resources while promoting effective management of the Bay and Delta. The Comprehensive Conservation and Management Plan (CCMP), the Estuary Project's blueprint to restore the Bay and Delta, was adopted and approved by the state and federal governments in 1993. An Implementation Committee meets quarterly to oversee implementation of the 144 CCMP actions. The Implementation Committee has representatives from the business, environmental and agricultural sectors, state and federal agencies and locally elected officials. Three geographic subcommittees representing the North Bay, South Bay and Delta assist the Implementation Committee with local CCMP implementation activities. If you would like to learn more about the San Francisco Estuary Project or the CCMP, please call (510) 286-0460.